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PAPER

CLIMATE CHANGE AND ITS RESEARCH MODELS

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Abstract

The impact of climate change on natural landscapes is being studied based on various scenarios. The article highlights the measures being undertaken to mitigate its effects, particularly on the natural landscape complexes of the Fergana Valley in the Republic of Uzbekistan.

Key words: climate change mitigation measures, landscape complexes, scenarios, models, greenhouse effect, aerosol gases.

Introduction

In recent years, climate change has increasingly affected all countries. Numerous practical efforts are being undertaken globally to adapt to and mitigate climate change. In Uzbekistan as well, large-scale initiatives such as the “Green Space” national project have been introduced to address global climate change. Comprehensive measures are being taken to ensure food security, reduce drought, and prevent degradation of fertile lands.

The decisions being developed in the field of climate change—by countries, international organizations, and scientific communities—aim to reduce negative impacts, improve ecological balance, ensure the rational use of natural resources, and preserve the environment for future generations. Many international agreements and conventions have been adopted to protect the atmosphere, hydrosphere, biosphere, and lithosphere from potential negative consequences.

Climate Models Studied

- **SSSM – Canadian Climate Centre Model**
- **UKMO – United Kingdom Meteorological Office Model**
- **GFDL – Geophysical Fluid Dynamics Laboratory (USA)**
- **GISS – Goddard Institute for Space Studies (USA)**

SSSM – Canadian Climate Centre Model

This scientific model is used for analyzing and forecasting climate change in Canada. It evaluates the concentration of greenhouse gases in the atmosphere and studies their effects on the climate. It also considers ocean-atmosphere interactions.

SSSM is used to model climate changes based on various scenarios using computer simulations to assess changes in global warming, precipitation, temperature, and winter durations. The model can project changes over a 100-year period, especially across large geographic areas such as Canada and surrounding regions.

UKMO – UK Meteorological Office Model

Developed by the UK Met Office, this climate model is widely used for studying climate change, global warming, and atmosphere-ocean interactions. It analyzes material and energy exchanges between the atmosphere and oceans.

Its focus includes SO_2 emissions, aerosols, cloud cover, and solar radiation. It models changes over 100 years and can predict both short- and long-term climate changes, considering human and natural factors.

GFDL – Geophysical Fluid Dynamics Laboratory Model

Used worldwide for climate modeling, this model integrates atmospheric circulation, ocean currents, tropospheric humidity and cloud patterns, greenhouse gases, and aerosols.

Unlike other models, GFDL accounts for Earth’s curvature and topographic variation, modeling changes in polar and high mountain glaciers. It simulates processes from the upper atmosphere to ocean depths and evaluates natural disasters, water resources, forest area changes, and temperature trends on a global scale.

GISS – NASA Goddard Institute for Space Studies Model

This model, developed by NASA, focuses on identifying, modeling, and forecasting long-term changes in the Earth’s atmosphere, oceans, glaciers, and cloud formations.

GISS supports NASA’s climate analyses and IPCC reports. It studies anthropogenic and natural factors affecting the atmosphere, greenhouse gas and aerosol concentrations, the greenhouse effect, and ozone layer impacts.

It also simulates moisture exchange, surface temperatures, precipitation, and ice melting, using precise historical satellite

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data.

Table 1. Climate Change Models

Model Name	Country / Institution	Full Name	Key Features	Advantages	Areas of Use
GISS	USA (NASA Goddard Institute)	Goddard Institute for Space Studies Climate Model	Integrates atmosphere, ocean, clouds, ice, and aerosols	High reliability, integrated with NASA data	Global forecasts, IPCC, NASA research
UKMO	UK (Met Office)	UK Met Office Hadley Centre Model (HadGEM)	Models atmosphere-ocean interaction, precipitation, and temperature changes	High precision, effective for regional forecasts	Europe, Africa, Central Asia studies
CCCM (CCCMa)	Canada (CCCma – Environment Canada)	Canadian Climate Centre for Modelling and Analysis Model (CGCM)	Well calculates greenhouse gases and surface heat balance	Accurate predictions for cold regions, strong Arctic focus	Arctic, North America, IPCC
GFDL	USA (NOAA – Princeton University)	Geophysical Fluid Dynamics Laboratory Climate Model	In-depth study of atmospheric and ocean fluid dynamics	Strong in water resources and sea-level modeling	Water balance, sea-level rise studies

Conclusion

It is necessary to develop specific models for arid climate zones. Models should take into account relief, mountain landscape exposure, and the location of countries in continental interiors. This would allow for more accurate climate modeling tailored to specific regions.

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